HKJOT 2007;17(2):39–44

The Application of Cognitive Orientation to Daily Occupational Performance (CO-OP) in Children with Developmental Coordination Disorder (DCD) in Hong Kong: A Pilot Study

Donna Y.K. Chan

Objective: Treatment approach for children with developmental coordination disorder (DCD) can be divided into: 1) the "bottom-up" approach, which includes sensory integration training, perceptual motor training and process-oriented approach, and 2) the "top-down" approach, which includes a recent new problem-solving approach, i.e. the cognitive orientation to daily occupational performance (CO-OP). This study is to investigate the effectiveness of CO-OP and to improve motor, cognitive and functional performance after treatment in children with DCD in a single-group pilot trial.
Methods: Six children with DCD were recruited consecutively by convenient sampling at a single time occasion. A treatment programme based on the CO-OP, which consisted of seven weekly sessions, was provided for all children in a closed group format. Motor, cognitive and functional performances were evaluated pre-/post-treatment.
Results: Significant differences after treatment were found in activity performance in motor planning, motor process, and daily life within the group.
Conclusion: The results indicated that the CO-OP focused in the cognitive domain helped to improve problem-solving skills and organization of daily chores in everyday life. This pilot study demonstrated the effectiveness of this new approach in clinical application and provided a good piece of preliminary evidence in the local context.

KEY WORDS: Cognitive orientation to daily occupational performance • Developmental coordination disorder • Problem solving

Background

The term developmental coordination disorder (DCD) was first introduced in 1987 (American Psychiatric Association, 1987) and was refined in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) in 1994. The diagnostic criteria include:

1. Performance in daily activities that require motor coordination is substantially below that expected, given the person's chronological age and measured intelligence. This may be manifested by marked delays in achieving motor milestone, poor performance in sports or poor handwriting.
2. The disturbance in criterion significantly interferes with academic achievement or activities of daily living.
3. The disturbance is not due to a general medical condition (e.g. cerebral palsy, hemiplegia or muscular dystrophy) and does not meet the criteria for a pervasive developmental disorder.

Child Assessment Centre, Department of Health, Hong Kong SAR, China.
Reprint requests and correspondence to: Ms. Donna Y.K. Chan, Occupational Therapist, Tuen Mun Child Assessment Centre, Department of Health, G/F Special Block, Tuen Mun Hospital, Tsing Chung Koon Road, Tuen Mun, Hong Kong SAR, China.
E-mail: donnachan03@netvigator.com

4. If mental retardation is present, the motor difficulties are in excess of those usually associated with it.

According to the DSM-IV, the prevalence of DCD has been estimated to be 6% in the age range of 5–11 years (American Psychiatric Association, 1994). Previous studies suggested that the prevalence of motor disorders in children is estimated to be around 5–8% of all school-aged children (Gubbay, 1975; Henderson & Hall, 1982; Maeland, 1992). They differ from one another, not only in the nature of their motor difficulties, but also in the extent to which they are affected by other problems. In the early years, they may be delayed in normal motor milestones. Later, their problems are manifested as delay in acquisition of functional skills, such as dressing, climbing stairs and manipulation tools. Apart from motor difficulties, they may also experience secondary emotional problems, such as low frustration tolerance, decreased self-esteem, and lack of motivation due to repeated failure in daily activities.

The treatment approach for children with DCD has been a great source of debate, because little is understood about the aetiology of the disorder. Traditionally, approaches have focused on remediating underlying processing deficits and facilitating neuromaturational development based upon the assumption that there is a direct relationship between underlying processes and functional performance; this is a "bottom-up" approach, which includes sensory integration training, perceptual motor training, and process-oriented approach. However, more recent theoretical perspectives have questioned this approach, and there has been an increase in interventions that focus directly on skill acquisition and improved performance (Mandich et al., 2001); this is the "top-down" problem-solving approach—the cognitive orientation to daily occupational performance (CO-OP).

The CO-OP was developed by Polatajko and colleagues in the early 1990s (Mandich et al., 2001; Miller et al., 2001; Missiuna et al., 2001; Polatajko et al., 1995a; Polatajko et al., 1995b; Polatajko, 1999; Polatajko et al., 2001a; Polatajko et al., 2001b). It is an approach of intervention that uses the power of cognition to drive successful performance. It is an individualized, client-centred approach that focuses on strategy-based skill acquisition. In the 1960s, motor learning and motor control theories were grounded in the idea that changes in motor behaviour and skill occurred as a result of maturation of the central nervous system. In 1967, Bernstein proposed that motor learning should be a process of solving movement problems. In the 1990s, the "dynamic systems theories" were proposed, and they suggested that new movement and motor control result from the collaboration of a person's musculoskeletal, neural and cognitive strategies and motivation to perform the tasks. In CO-OP, it believed that the child will solve movement problem through explicit and implicit learning. The therapists or parents only act as an important role to assist the child to solve the difficult problem using cognitive strategies, e.g. changing the body position in a right way to catch a ball, calibration of the force of the hands when cutting sandwiches, organizing the table when stuck on the homework or packing a schoolbag. The child learns the strategies by repetitive practice of tasks of similar cognitive demands, which are then reinforced by the therapists or parents. Vygotsky (1987) believed that children are able to learn to solve a problem through verbal instruction, and therefore, in CO-OP, a child needs to be guided through problem solving by saying aloud in order to learn to regulate his behaviour by self-instruction. They also used the scaffolding of problem solving of Meichenbaum & Goodman (1971), i.e. Goal-Plan-Do-Check, as a global strategy of problem solving in daily activities. One of the key features of CO-OP is the combination of strategies as outlined by Feuerstein et al. (1986) to facilitate learning by means of process questioning, bridging, describing, modelling, and feedback, for what therapists or

Table. Comparison of results pre-/post-treatment ($n = 6$)

Instrument	Measurement	Mean (SD)	Z	*p*
BO Test	Pre	12.67 (2.73)	–1.000	0.317
	Post	13.00 (2.45)		
AMPS (motor)	Pre	0.69 (0.20)	–2.226	0.026*
	Post	1.11 (0.47)		
AMPS (process)	Pre	–0.48 (0.54)	–2.226	0.026*
	Post	0.34 (0.71)		
COPM (performance)	Pre	13.00 (3.63)	–2.060	0.039*
	Post	19.00 (2.45)		
COPM (satisfaction)	Pre	12.67 (3.83)	–2.032	0.042*
	Post	19.00 (2.45)		

*$p \leq 0.05$. SD = standard deviation; BO Test = fine motor part of the Bruininks-Oseretsky Motor Proficiency Test; AMPS = motor and process parts of the Assessment Motor and Process Skills; COPM = performance and satisfaction scores of the Canadian Occupational Performance Measure.

parents had taught. It will elicit a child's learning in other daily living activities. There are altogether six key principles in CO-OP: (1) session structure; (2) chosen goals; (3) dynamic performance analysis; (4) cognitive strategies, which include global and specific strategies; (5) enabling principle; and (6) parent involvement (Polatajko et al., 2001b).

The aim of this study was to investigate the effectiveness of the CO-OP approach to improve motor, cognitive and functional performances after treatment in children with DCD in a single-group pilot trial.

Methodology

Subjects

Six children with DCD, who were outpatients from a child assessment centre in Hong Kong, were recruited consecutively by convenient sampling at a single time occasion. The mean age was 8.8 years (standard deviation, SD = 0.55). The ratio of male to female was 1:1. The inclusion criteria were: (1) aged 8 to 10 years; (2) studying in Primary 4 to 6 in mainstream primary schools; (3) diagnosed with DCD by a multidisciplinary assessment, which included a paediatrician, clinical psychologist, and occupational therapist, etc. from the child assessment centre; (4) absence of other medical or developmental diseases that would affect physical and cognitive performances; (5) not receiving occupational therapy treatment anywhere else during the study period, or having completed occupational therapy treatment previously but with parents still complaining of their child's clumsiness in daily living activities; and (6) parents willing and committed to carry out the home programme. The case occupational therapist, who was the principal investigator of this pilot study, explained the detailed information to the eligible participants and their parents before the study. Those who agreed to join the study were asked to sign a consent form before participation.

The programme that used the CO-OP for all participants in this study is listed in the Appendix. It consisted of seven sessions, which were run once weekly, in a closed-group format. Each session lasted for 2 hours. Parents were invited to be the observers in the group, so that they could learn and help their children to practice the tasks and do the homework at home.

Instruments

The outcome measure instruments included three measurements for motor, cognitive and functional performances, respectively. They are: (1) the fine motor part of the Bruininks-Oseretsky Motor Proficiency Test (BO Test), which measured the fine motor skills (Bruininks, 1978); (2) the motor and process parts of the Assessment Motor and Process Skills (AMPS), which measured motor planning (Fisher, 1994); and (3) the performance and satisfaction scores of the Canadian Occupational Performance Measure (COPM), which evaluated the self-perceived improvement in performance and functions (Law et al., 1991). All instruments were measured 1 week before and after the treatment by the principal investigator.

The BO Test is a norm-referenced, standardized test developed by Bruininks (1978) from a sample of 800 American children to screen or assess the motor skills of children aged 4.5–14.5 years. The instrument consists of eight subtests comprising 46 items. Subtests 1, 2, 3 and 4 measure gross motor skills, subtests 6, 7 and 8 measure fine motor skills, while subtest 5 measures both gross and fine motor skills. The fine motor part of the BO Test includes subtests 5 to 8. Nine items of subtest 5 (upper-limb coordination) assess the coordination of visual tracking with movements of arms and hands, as well as the precise movements of arms, hands or fingers. One item of subtest 6 (response speed) measures the ability to respond to a moving visual stimulus. Eight items of subtest 7 (visual-motor control) measure the ability to coordinate precise hand and visual movements. Eight items of subtest 8 (upper-limb speed and dexterity) measure hand and finger dexterity, hand speed, and arm speed. This study used the Hong Kong norm established for the fine motor composite (Chui et al., 2007). The AMPS is a top-down, standardized observational assessment of functional ability that, unlike many standardized tests traditionally used by occupational therapists, has been developed for use by occupational therapists (Fisher, 1994). The AMPS can be administered in any environment. It involves the person describing his or her daily routines and then choosing two or three familiar activities for the occupational therapist to observe. This assessment allows therapists to simultaneously observe and evaluate a person's ability to perform activities of daily living (domestic and personal) and the quality of his or her motor and process skills. The AMPS is suitable for use with any person from 3 years of age with any functional limitation. The COPM is a semi-structured interview developed by therapists of the Canadian Association of Occupational Therapists (Law et al., 1991). It is a client-centred assessment designed to help clients identify problems in occupational performance, which incorporates roles and role expectation, from within the client's living environment. The COPM considers the importance to the person of the occupational performance areas, as well as the client's satisfaction with the present performance, and the client rates the areas using a 10-point scale on perceived performance and satisfaction (Law et al., 1991). Instead of using five topic areas, a modified format of asking the child three important areas in daily activities were used in this study.

Non-parametric statistical method using the SPSS statistical software version 12.0 (SPSS Inc., Chicago, IL, USA) was used to compute the data. The Wilcoxon signed rank test was used to find the pre-/post-treatment differences within the treatment group. The level of significance (p) was set at 0.05.

Results

The results of pre-/post-treatment comparisons are listed in the Table. There were significant differences between pre- and post-measurements in both the motor or process parts of the AMPS, as well as the performance and satisfaction scores of the COPM within the group ($p \leq 0.05$). There was no significant difference in the fine motor part of the BO Test before and after the treatment.

Discussion

This pilot study demonstrated its effectiveness in clinical application and provided a piece of preliminary evidence in the local context. The significant results in activity performance as measured by AMPS and COPM, together with the insignificant results of the BO Test after treatment, indicated that the CO-OP focused on the cognitive domain specifically to improve problem-solving skills and organization of daily chores in everyday life rather than enhancing the motor skills performance, especially in fine coordination. The results of this study were consistent with those reported in previous literature in that the CO-OP did help to improve the motor planning over the motor process but not the actual motor skills in performance (Polatajko et al., 2001a; Miller et al., 2001).

CO-OP is a new approach in treatment of children with DCD. It is an individualized, client-centred approach that is focused on strategy-based skill acquisition. It is essentially a cognitive approach to solving daily occupational performance problems. In CO-OP, a global problem-solving strategy is used to frame the development of domain-specific strategies that enable successful task performance and promote skill acquisition. It is a highly verbal approach in which cognitive strategies are mapped onto performance to facilitate and support performance. Besides, it aims to teach the child with DCD to learn a global problem-solving strategy, mind mapping, and domain-specific strategies. The children can generalize the learnt skill and techniques in different daily living situations in different environments. This means the child is capable of making his/her bacon-and-egg sandwich and packing it tidily in his/her familiar kitchen. They can also generalize the skills, e.g. to organize their school bags, by using the global problem-solving strategy and domain-specific skills.

For the CO-OP approach to be successful, there are a number of prerequisites for all involved parties, including the child, his/her parents and/or caregivers, teachers, and the therapist. First of all, the children should have sufficient cognitive and language ability to respond to the CO-OP. They should have same occupational goals relating to the daily living activities, and both children and parents should be committed to implement the approach beyond the treatment period, at home and at school. Moreover, a daily activity log for the child should be given to and completed by parents, so that therapists can know whether the child has actually used the skills at home, which he/she learnt during the treatment session.

Besides, the occupational therapist should have effective communication skills to implement the CO-OP, which requires highly cognitive orientation and clear verbal guidance. The verbal guidance should gradually fade out as the child's ability improves. It is also difficult for parents to learn this fading process of verbal guidance. One way to overcome this is to reinforce the self-instruction from "overt", i.e. by saying aloud, to "covert", i.e. by whispering the instructions or using inner speech (Meichenbaum & Goodman, 1971). Besides, both the therapist and parents should bear in mind that the CO-OP is a child-centred framework. We should not force the child to do the tasks that he/she is not motivated in doing. Lastly, both the therapist and parents should have excellent skills in task analysis in order to enhance the child's problem-solving skills. They played an important part to assist the child in finding out the problem and guiding the child to alternative ways gradually, but not totally instructing the child to follow the plan. Repetitive practice with feedback using role play, therefore, should be considered in the group so as to reinforce the parents' skills in facilitating their children.

There were a number of limitations in this study. Since it was a pilot study aimed at a single group programme evaluation, the sample size was small, and it might not be conclusive enough to prove that the treatment was applicable to large samples in the local population. The investigator of this study also served as the assessor and was not blinded to the assessments. Further improvement can be considered by including standardized cognitive tests as outcomes in order to detect any cognitive changes in the children. Moreover, a large-scale prospective randomized controlled trial comparing the CO-OP with other kinds of traditional treatment in children with DCD should be conducted to substantiate its clinical effectiveness.

Conclusion

The CO-OP is a new treatment approach for children with DCD and provides an alternative "top-down" approach for

occupational therapists to use. This pilot study demonstrated its effectiveness in clinical application and provided a piece of preliminary evidence in the local context. In contrast to traditional treatment approaches, it focuses directly on child-identified performance issues and engages the child as an active problem solver and active participant in the treatment process. Further large-scale controlled study is needed to investigate its effectiveness for children with DCD.

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Appendix. Programme structure

Session	Contents
Session 1	Assessment 1. The fine motor part of the Bruininks-Oseretsky Motor Proficiency Test (BO Test). 2. The Assessment Motor of Process Skill (AMPS). 3. The Canadian Occupational Performance Measure (COPM) and each child has to identify three personal goals in this measurement.
Session 2	Introduction 1. The occupational therapist introduces the concept of the global cognitive strategy, Goal-Plan-Do-Check, to the parents and children separately. 2. The therapist and child or therapist and parents map the Goal-Plan-Do-Check to a familiar task and play a funny game to get the concept through. 3. Introduce a worksheet of mind mapping to the child and parents through a game.
Sessions 3–6	Acquisition 1. Facilitate the child's acquisition and application of the global cognitive strategy Goal-Plan-Do-Check. 2. Guide discovery of the domain-specific strategies and mediate their application to skill acquisition. 3. Application of Goal-Plan-Do-Check and specific strategies in daily living activities, such as making sandwiches with vegetables, eggs and bacon, making a cup of tea, cooking instant noodles, packing the school bag, folding clothes, washing dishes after meal, etc. 4. Teach parents about Goal-Plan-Do-Check and domain-specific strategies. 5. Educate parents about their ongoing important role in facilitating cognitive strategy use to promote skill acquisition at home. 6. All parents are requested to observe their child's performance through one-way mirror. The whole treatment process is videotaped. It facilitates therapists in teaching the parents on using technical verbal guidance at specific skill.
Session 7	Consolidation 1. Emphasize the generalization skill of Goal-Plan-Do-Check, the domain-specific strategies, and mind mapping skills to the child in different daily living situation. 2. Reinforce parents to play a mediator role consistently at home by using the strategies that they have learned in CO-OP. 3. Reassessment using BO Test, COPM, and AMPS by the occupational therapist before completion of session 7.